

WHAT IS CLAIMED IS:

1. Storage system having a plurality of disk drives, wherein

at least one of said disk drives of the storage system is a spare disk drive, and

said storage system monitors a status of error occurrence in each of said disk drives, starts mirroring between that disk drive and said spare disk drive when a number of errors occurred of said disk drive exceeds a specified first value and performs reading from said spare disk drive when said number of errors occurred of said disk drive exceeds a specified second value greater than said specified value level 1.

2. Storage system having a plurality of disk drives, wherein

at least one of said disk drives of the storage system is a spare disk drive, and

said storage system has:

an error monitor section which monitors a status of error occurrence in each of said disk drives and instructs initiation of mirroring between that disk drive and said spare disk drive when a number of errors occurred of said disk drive exceeds a specified first value , instructs initiation of blockade of said disk drive when said number of errors occurred of said disk drive exceeds a specified second value greater than said specified first value, and instructs shifting of a process which has been performed by said disk drive to

said spare disk drive,

a mirror section which performs mirroring between
said disk drive and said spare disk drive, and

5 a blockade/shift section which performs blockade
of said disk drive and said shifting.

3. Storage system having a plurality of disk
drives, wherein

at least one of said disk drives of the storage
system is a spare disk drive, and

10 said storage system has:

an error monitor section which monitors a status
of error occurrence in each of said disk drives and
instructs initiation of mirroring between that disk
drive and said spare disk drive when a number of errors
15 occurred of said disk drive exceeds a specified value,
clears mirroring of said spare disk drive when a number
of errors occurred of that disk drive which is not
undergoing mirroring exceeds said number of errors
occurred of said disk drive that is undergoing
20 mirroring, and instructs initiation of mirroring
between said disk drive not undergoing mirroring and
said mirroring-cleared spare disk drive, and

a mirror section which performs mirroring between
said disk drive and said spare disk drive.

25 4. Storage system having a plurality of disk
drives laid in an array, wherein

at least one of said disk drives of the storage
system is a spare disk drive, and

said storage system has:

an error monitor section which monitors a status of error occurrence in each of said disk drives and gives such an instruction as to set the status of said disk drive in a temporarily blocked state, and

a data restoring section which, when a disk drive constituting a disk array group becomes said temporary blocked state, restores data of said temporary blocked disk drive from another disk drive constituting said disk array group to said spare disk drive, and performs reading from said temporary blocked disk drive when reading from said another disk drive constituting said disk array group is not possible during data restoration.

5. Storage system having a plurality of disk drives, wherein at a time of data shifting between disk drives, a number of read errors occurred from a data-shifting disk drive is stored, data from said data-shifting disk drive is read into a shifting-destination disk drives until said number of errors occurred reaches a specified value, data reading is switched to data reading from a disk drive constituting a disk array group when said number of errors occurred reaches said specified value, and data reading from said data-shifting disk drive is executed when data reading from said disk drive constituting said disk array group is in error and data restoration is not possible.

6. The storage system according to claim 5,

wherein after data reading is switched to data reading from said disk drive constituting said disk array group, when data reading from said disk drive constituting said disk array group is in error, data reading is switched to data reading from said data-shifting disk drive and that data reading is successful, data of that disk drive constituting said disk array group which has had a read error is restored by using said data read from said data-shifting disk drive and said data from said disk drive constituting said disk array group.

7. Storage system having an array of disk drives, at least one of which is a spare disk drive, wherein said storage system has:

an error monitor section which monitors a status of error occurrence in each of said disk drives with a disk array group constituted by said disk drives as one unit, and instructs initiation of shifting of data of that disk drive whose number of errors occurred exceeds a specified value to said spare disk drive,

an error-count specified value changing section which dynamically changes said specified value to a smaller value when said numbers of errors occurred of said plurality of disk drives of said disk array group reach a sub specified value set smaller than said specified value, and

a copy section which performs data copying upon reception of that shifting instruction.

8. An error monitor control program for storage

system having a plurality of disk drives, at least one of which is a spare disk drive, wherein

said error monitor control program monitors a status of error occurrence in each of said disk drives, starts mirroring between that disk drive and said spare disk drive when a number of errors occurred of said disk drive exceeds a specified first value and performs reading from said spare disk drive when said number of errors occurred of said disk drive exceeds a specified second value greater than said specified first value .

9. An error monitor control program for storage system having an array of disk drives, at least one of which is a spare disk drive, wherein

said error monitor control program has:

an error monitor program which monitors a status of error occurrence in each of said disk drives and instructs initiation of mirroring between that disk drive and said spare disk drive when a number of errors occurred of said disk drive exceeds a specified first value , instructs initiation of blockade of said disk drive when said number of errors occurred of said disk drive exceeds a specified second value greater than said specified first value, and instructs shifting of a process which has been performed by said disk drive to said spare disk drive,

a mirror program which performs mirroring between said disk drive and said spare disk drive, and

a blockade/shift program which performs blockade

of said disk drive and said shifting.

10. An error monitor control program for storage system having a plurality of disk drives, at least one of which is a spare disk drive, wherein

5 said error monitor control program has:

 an error monitor program which monitors a status of error occurrence in each of said disk drives and instructs initiation of mirroring between that disk drive and said spare disk drive when a number of errors
10 occurred of said disk drive exceeds a specified value, clears mirroring of said spare disk drive when a number of errors occurred of that disk drive which is not undergoing mirroring exceeds said number of errors
15 occurred of said disk drive that is undergoing mirroring, and instructs initiation of mirroring between said disk drive not undergoing mirroring and said mirroring-cleared spare disk drive, and

 a mirror program which performs mirroring between said disk drive and said spare disk drive.

20 11. An error monitor control program for storage system having a plurality of disk drives laid in an array, at least one of which is a spare disk drive, wherein

 said error monitor control program has:

25 an error monitor program which monitors a status of error occurrence in each of said disk drives and gives such an instruction as to set the status of said disk drive in a temporarily blocked state, and

a data restoring program which, when a disk drive constituting a disk array group becomes said temporary blocked state, restores data of said temporary blocked disk drive from another disk drive constituting said disk array group to said spare disk drive, and performs reading from said temporary blocked disk drive to thereby ensure data restoration when reading from said another disk drive constituting said disk array group is not possible during data restoration.

12. An error monitor control program for storage system having an array of disk drives, comprising:

an error count storing program which, at a time of data shifting between disk drives, stores a number of read errors occurred from a data-shifting disk drive, and

a data monitoring/shifting program which reads data from said data-shifting disk drive into a shifting-destination disk drives until said number of errors occurred reaches a specified value, switches data reading to data reading from a disk drive constituting a disk array group when said number of errors occurred reaches said specified value, and executes data reading from said data-shifting disk drive only when data reading from said disk drive constituting said disk array group is in error and data restoration is not possible.

13. The error monitor control program according to claim 12, further having a data restoration program

by which, when data reading from said disk drive
constituting said disk array group is in error after
data reading is switched to data reading from said disk
drive constituting said disk array group, data reading
5 is switched to data reading from said data-shifting
disk drive only when data restoration is not possible
and that data reading is successful, data of that disk
drive constituting said disk array group which has had
a read error is restored by using said data read from
10 said data-shifting disk drive and said data from said
disk drive constituting said disk array group.

14. An error monitor control program for storage
system having a plurality of disk drives, at least one
of which is a spare disk drive, wherein

15 said error monitor control program has:

an error monitor program which monitors a status
of error occurrence in each of said disk drives with a
disk array group constituted by said disk drives as one
unit, and instructs initiation of shifting of data of
20 that disk drive whose number of errors occurred exceeds
a specified value to said spare disk drive,

an error-count specified value changing program
which dynamically changes said specified value to a
smaller value when said numbers of errors occurred of
25 said plurality of disk drives of said disk array group
reach a sub specified value set smaller than said
specified value, and

a copy program which performs data copying upon

reception of that shifting instruction.

15. An error monitor control method for storage system having a plurality of disk drives, at least one of which is a spare disk drive, wherein

5 said error monitor control method includes:

 an error monitor method which monitors a status of error occurrence in each of said disk drives, and starts mirroring between that disk drive and said spare disk drive when a number of errors occurred of said disk drive exceeds a specified first value , and

10 a reading method which performs reading from said spare disk drive when said number of errors occurred of said disk drive exceeds a specified second value greater than said specified first value .

15 16. An error monitor control method for storage system having an array of disk drives, at least one of which is a spare disk drive, wherein

 said error monitor control method includes:

 an error monitor method which monitors a status
20 of error occurrence in each of said disk drives and instructs initiation of mirroring between that disk drive and said spare disk drive when a number of errors occurred of said disk drive exceeds a specified first value , instructs initiation of blockade of said disk
25 drive when said number of errors occurred of said disk drive exceeds a specified second value greater than said specified first value , and instructs shifting of a process which has been performed by said disk drive

to said spare disk drive,

a mirror method which performs mirroring between said disk drive and said spare disk drive, and

5 a blockade/shift method which performs blockade of said disk drive and said shifting.

17. An error monitor control method for storage system having a plurality of disk drives, at least one of which is a spare disk drive, wherein

said error monitor control method includes:

10 an error monitor method which monitors a status of error occurrence in each of said disk drives and instructs initiation of mirroring between that disk drive and said spare disk drive when a number of errors occurred of said disk drive exceeds a specified value,
15 clears mirroring of said spare disk drive when a number of errors occurred of that disk drive which is not undergoing mirroring exceeds said number of errors occurred of said disk drive that is undergoing mirroring, and instructs initiation of mirroring
20 between said disk drive not undergoing mirroring and said mirroring-cleared spare disk drive, and

a mirror monitor method which performs mirroring between said disk drive and said spare disk drive.

25 18. An error monitor control method for storage system having a plurality of disk drives laid in an array, at least one of which is a spare disk drive, wherein

said error monitor control method includes:

an error monitor method which monitors a status of error occurrence in each of said disk drives and gives such an instruction as to set the status of said disk drive in a temporarily blocked state, and

5 a data restoring method which, when a disk drive constituting a disk array group becomes said temporary blocked state, restores data of said temporary blocked disk drive from another disk drive constituting said disk array group to said spare disk drive, and performs
10 reading from said temporary blocked disk drive to thereby ensure data restoration when reading from said another disk drive constituting said disk array group is not possible during data restoration.

19. A data shifting method for storage system
15 having an array of disk drives, including:

an error count storing method which, at a time of data shifting between disk drives, stores a number of read errors occurred from a data-shifting disk drive, and

20 a data monitoring/shifting method which switches data reading to data reading from a disk drive constituting a disk array group when said number of errors occurred reaches said specified value, and executes data reading from said data-shifting disk
25 drive when data reading from said disk drive constituting said disk array group is in error and data restoration is not possible.

20. The data shifting method according to claim

19, further having a data restoration method by which,
when data reading from a redundant disk drive is in
error after data reading is switched to a system of
data reading/data restoring from said disk drive

5 constituting said disk array group, data reading is
switched to data reading from said data-shifting disk
drive only when data restoration is not possible and
that data reading is successful, data of that disk
drive constituting said disk array group which has had
10 a read error is restored by using said data read from
said data-shifting disk drive and said data from said
disk drive constituting said disk array group.

21. A data shifting method for storage system
having a plurality of disk drives, at least one of
15 which is a spare disk drive, wherein

said data shifting method includes:

an error monitor method which monitors a status
of error occurrence in each of said disk drives with a
disk array group constituted by said disk drives as one
20 unit, and instructs initiation of shifting of data of
that disk drive whose number of errors occurred exceeds
a specified value to said spare disk drive,

an error-count specified value changing method
which dynamically changes said specified value to a
25 smaller value when said number of said disk array group
reaches a sub specified value set smaller than said
specified value, and

a copy method which performs data copying upon

reception of that shifting instruction.